

### AMENDMENTS TO THE CLAIMS

The following claim listing will replace all prior versions, and listings, of claims in this application:

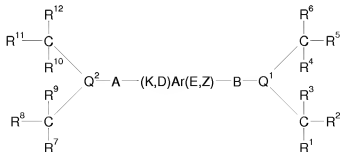
1. (Canceled).
2. (Previously presented) A process according to claim 30, wherein the ratio of branched:linear product from carbonylation process is greater than 1.5:1.
3. (Currently amended) A process for the carbonylation of vinyl ester comprising reacting a vinyl ester compound of formula (IV)

(IV)



wherein  $R^{29}$  may be selected from hydrogen, lower alkyl, aryl, halo, cyano, nitro,  $OR^{19}$ ,  $OC(O)R^{20}$ ,  $C(O)R^{21}$ ,  $C(O)OR^{22}$ ,  $NR^{23}R^{24}$ ,  $C(O)NR^{25}R^{26}$ ,  $C(S)NR^{25}R^{26}$ ,  $SR^{27}$ , and  $C(O)SR^{29}$  wherein  $R^{12}$ – $R^{18}$  and  $R^{19}$ – $R^{27}$  are as defined below and  $R^{30}$ – $R^{32}$  independently represent hydrogen, lower alkyl, or aryl as defined herein, with carbon monoxide in the presence of a source of hydroxyl groups and of a catalyst system, the catalyst system obtainable by combining:

- (a) a metal of Group VIII B or a compound thereof; and
- (b) a bidentate phosphine, arsine or stibine of formula (I)



wherein:

Ar is a bridging group being an aryl moiety to which the Q<sup>1</sup> and Q<sup>2</sup> atoms are linked on available adjacent carbon atoms;

A and B each independently represent lower alkylene;

K, D, E and Z are substituents of the aryl moiety (Ar) and each independently represent hydrogen, lower alkyl, aryl, halo, cyano, nitro, OR<sup>19</sup>, OC(O)R<sup>20</sup>, C(O)R<sup>21</sup>, C(O)OR<sup>22</sup>, NR<sup>23</sup>R<sup>24</sup>, C(O)NR<sup>25</sup>R<sup>26</sup>, C(S)NR<sup>25</sup>R<sup>26</sup>, SR<sup>27</sup>, C(O)SR<sup>27</sup>, or -J-Q<sup>3</sup>(CR<sup>13</sup>(R<sup>14</sup>)(R<sup>15</sup>))CR<sup>16</sup>(R<sup>17</sup>)(R<sup>18</sup>) where J represents lower alkylene; or two adjacent groups selected from K, Z, D and E together with the carbon atoms of the aryl ring to which they are attached form a further phenyl ring, which is optionally substituted by one or more substituents selected from hydrogen, lower alkyl, halo, cyano, nitro, OR<sup>19</sup>, OC(O)R<sup>20</sup>, C(O)R<sup>21</sup>, C(O)OR<sup>22</sup>, NR<sup>23</sup>R<sup>24</sup>, C(O)NR<sup>25</sup>R<sup>26</sup>, ~~C(S)NR<sup>25</sup>R<sup>26</sup>~~, C(S)NR<sup>25</sup>R<sup>26</sup>, SR<sup>27</sup> and C(O)SR<sup>27</sup> or, when Ar is a cyclopentadienyl group, Z may be represented by -M(L<sub>1</sub>)<sub>n</sub>(L<sub>2</sub>)<sub>m</sub> and Z is connected via a metal ligand bond to the cyclopentadienyl group;

R<sup>1</sup> to R<sup>18</sup> each independently represent lower alkyl, or aryl;

R<sup>19</sup> to R<sup>27</sup> each independently represent hydrogen, lower alkyl, or aryl;

M represents a Group VIB or VIIB metal or metal cation thereof;

L<sub>1</sub> represents a cyclopentadienyl, indenyl or aryl group each of which groups are optionally substituted by one or more substituents selected from hydrogen, lower alkyl, halo, cyano, nitro, OR<sup>19</sup>, OC(O)R<sup>20</sup>, C(O)R<sup>21</sup>, C(O)OR<sup>22</sup>, NR<sup>23</sup>R<sup>24</sup>, C(O)NR<sup>25</sup>R<sup>26</sup>, C(S)NR<sup>25</sup>R<sup>26</sup>, SR<sup>27</sup>, C(O)SR<sup>27</sup> and ferrocenyl;

L<sub>2</sub> represents one or more ligands each of which are independently selected from hydrogen, lower alkyl, alkylaryl, halo, CO, PR<sup>43</sup>R<sup>44</sup>R<sup>45</sup> and NR<sup>46</sup>R<sup>47</sup>R<sup>48</sup>;

R<sup>43</sup> to R<sup>48</sup> each independently represent hydrogen, lower alkyl, or aryl;

n = 0 or 1;

and  $m = 0$  to 5;

provided that when  $n = 1$  then  $m$  equals 0, and when  $n$  equals 0 then  $m$  does not equal 0;

$Q^1$ ,  $Q^2$  and  $Q^3$  each independently represent phosphorus, arsenic or antimony.

4. (Canceled).

5. (Previously presented) A process according to claim 30, wherein the Group VIII B metal is palladium.

6. (Previously presented) A process according to claim 30, wherein the linear ( $n$ ) and branched ( $iso$ ) products of the carbonylation may be separated either before or after the step of chemically treating the product.

7. (Previously presented) A process according to claim 30, wherein the products of the reaction are separated by distillation.

8. (Previously presented) A process according to claim 30, wherein when K, D, E or Z represent  $-J-Q^3(CR^{13}(R^{14})(R^{15}))CR^{16}(R^{17})(R^{18})$ , the respective K, D, E or Z is on the aryl carbon adjacent the aryl carbon to which A or B is connected or, if not so adjacent, is adjacent a remaining K, D, E or Z group which itself represents  $-J-Q^3(CR^{13}(R^{14})(R^{15}))CR^{16}(R^{17})(R^{18})$ .

9. (Canceled)

10. (Previously presented) A process according to claim 30, wherein the carbon monoxide may be used in pure form or diluted with an inert gas

11. (Previously Presented) A process according to claim 30, wherein the ratio (volume/volume) of vinyl acetate compound to compound providing a source of hydroxyl groups lies in the range of 1:0.1 to 1:10.

12. (Previously presented) A process according to claim 30, wherein the amount of Group VIII B metal is in the range  $10^{-7}$  to  $10^{-1}$  moles per mole of vinyl acetate compound.

13. (Previously presented) A process according to claim 30, wherein the carbonylation of a vinyl acetate compound is performed in one or more aprotic solvents.
14. (Original) A process according to claim 13, wherein the aprotic solvent has a dielectric constant that is below 50 at 298.15 K and at  $1 \times 10^5 \text{ Nm}^{-2}$ .
15. (Previously presented) A process according to claim 30, wherein the catalyst compounds act as a heterogeneous catalyst.
16. (Previously presented) A process according to claim 30, wherein the catalyst compounds act as a homogeneous catalyst.
17. (Original) A process according to claim 15 wherein the process is carried out with the catalyst comprising a support.
18. (Original) A process according to claim 17, wherein the support is insoluble.
19. (Previously presented) A process according to claim 17, wherein the support comprises a polymer, a silicon compound, or other porous particulate material.
20. (Previously presented) A process according to claim 30, wherein the carbonylation is carried out at a temperature of between  $-10$  and  $150^\circ\text{C}$ .
21. (Previously presented) A process according to claim 30, wherein the carbonylation is carried out at a CO partial pressure of between  $0.80 \times 10^5 \text{ N.m}^{-2}$  –  $90 \times 10^5 \text{ N.m}^{-2}$ .
22. (Previously presented) A process according to claim 30, wherein the carbonylation is carried out at a low CO partial pressure of between  $0.1$  to  $5 \times 10^5 \text{ N.m}^{-2}$ .
23. (Currently Amended) A process according to claim 30, wherein the bidentate phosphine is independently selected from any of the following: bis (di-*t*-butyl phosphino)-*o*-xylene; 1,2 bis (diadamantylphosphinomethyl) benzene; 1,2 bis (diadamantylphosphinomethyl) naphthalene; 1,2 bis (di-*t*-pentyl phosphino)-*o*-xylene (also known as 1,2 bis (di-*t*-pentyl phosphinomethyl) benzene); bis 2,3 (di-*t*-butyl phosphinomethyl) naphthalene; 1,2-bis-(di-*t*-butylphosphinomethyl) ferrocene; 1,2,3-tris-

(diterbutylphosphinomethyl) ferrocene; 1,2 bis (diadamantylphosphinomethyl) ferrocene; and 1,2 bis (di-t-pentyl phosphinomethyl) ferrocene.

24. (Canceled)

25. (Canceled)

26. (Canceled)

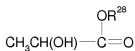
27. (Previously presented) A process according to claim 30, wherein chemically treating comprises hydrolysis or transesterification.

28. (Previously presented) A process according to claim 27, wherein chemically treating comprises hydrolysis and the product is hydrogenated subsequent to hydrolysis.

29. (Previously presented) A process according to claim 3 for producing mainly branched product.

30. (Previously presented) A process for the production of a lactate ester or acid of formula II

(II)



wherein  $\text{R}^{28}$  is selected from H, a  $\text{C}_1$ - $\text{C}_{30}$  alkyl moiety which may be branched or linear, and a  $\text{C}_1$ - $\text{C}_{30}$  aryl moiety,

comprising the steps of carbonylating a ester compound of formula (IV)

(IV)

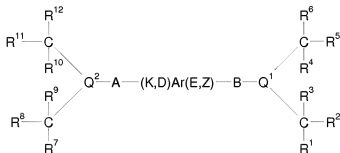


wherein  $\text{R}^{29}$  may be selected from hydrogen, lower alkyl, aryl, halo, cyano, nitro,  $\text{OR}^{19}$ ,  $\text{OC}(\text{O})\text{R}^{20}$ ,  $\text{C}(\text{O})\text{R}^{21}$ ,  $\text{C}(\text{O})\text{OR}^{22}$ ,  $\text{NR}^{23}\text{R}^{24}$ ,  $\text{C}(\text{O})\text{NR}^{25}\text{R}^{26}$ ,  $\text{SR}^{27}$ , and  $\text{C}(\text{O})\text{SR}^{29}$  wherein  $\text{R}^{12}$ - $\text{R}^{18}$  and  $\text{R}^{19}$ - $\text{R}^{27}$  are as

defined below, and  $R^{30}$ - $R^{32}$  represent hydrogen, with carbon monoxide in the presence of a source of hydroxyl groups and of a catalyst system, the catalyst system obtainable by combining:

- (a) a metal of Group VIII B or a compound thereof; and
- (b) a bidentate phosphine, arsine or stibine of formula (I)

(I)



wherein:

Ar is a bridging group being an aryl moiety to which the  $Q^1$  and  $Q^2$  atoms are linked on available adjacent carbon atoms;

A and B each independently represent lower alkylene;

K, D, E and Z are substituents of the aryl moiety (Ar) and each independently represent hydrogen, lower alkyl, aryl, halo, cyano, nitro,  $OR^{19}$ ,  $OC(O)R^{20}$ ,  $C(O)R^{21}$ ,  $C(O)OR^{22}$ ,  $NR^{23}R^{24}$ ,  $C(O)NR^{25}R^{26}$ ,  $C(S)NR^{25}R^{26}$ ,  $SR^{27}$ ,  $C(O)SR^{27}$ , or  $-J-Q^3(CR^{13}(R^{14})(R^{15}))CR^{16}(R^{17})(R^{18})$  where J represents lower alkylene; or two adjacent groups selected from K, Z, D and E together with the carbon atoms of the aryl ring to which they are attached form a further phenyl ring, which is optionally substituted by one or more substituents selected from hydrogen, lower alkyl, halo, cyano, nitro,  $OR^{19}$ ,  $OC(O)R^{20}$ ,  $C(O)R^{21}$ ,  $C(O)OR^{22}$ ,  $NR^{23}R^{24}$ ,  $C(O)NR^{25}R^{26}$ ,  $C(S)NR^{25}R^{26}$ ,  $SR^{27}$  and  $C(O)SR^{27}$  or, when Ar is a cyclopentadienyl group, Z may be represented by  $-M(L_1)_n(L_2)_m$  and Z is connected via a metal ligand bond to the cyclopentadienyl group;

$R^1$  to  $R^{18}$  each independently represent lower alkyl, or aryl;

$R^{19}$  to  $R^{27}$  each independently represent hydrogen, lower alkyl, or aryl;

M represents a Group VIB or VIIB metal or metal cation thereof;

L<sub>1</sub> represents a cyclopentadienyl, indenyl or aryl group each of which groups are optionally substituted by one or more substituents selected from hydrogen, lower alkyl, halo, cyano, nitro, OR<sup>19</sup>, OC(O)R<sup>20</sup>, C(O)R<sup>21</sup>, C(O)OR<sup>22</sup>, NR<sup>23</sup>R<sup>24</sup>, C(O)NR<sup>25</sup>R<sup>26</sup>, C(S)NR<sup>25</sup>R<sup>26</sup>, SR<sup>27</sup>, C(O)SR<sup>27</sup> and ferrocenyl;

L<sub>2</sub> represents one or more ligands each of which are independently selected from hydrogen, lower alkyl, alkylaryl, halo, CO, PR<sup>43</sup>R<sup>44</sup>R<sup>45</sup> and NR<sup>46</sup>R<sup>47</sup>R<sup>48</sup>;

R<sup>43</sup> to R<sup>48</sup> each independently represent hydrogen, lower alkyl, or aryl;

n = 0 or 1;

and m = 0 to 5;

provided that when n = 1 then m equals 0, and when n equals 0 then m does not equal 0; and

Q<sup>1</sup>, Q<sup>2</sup> and Q<sup>3</sup> each independently represent phosphorous, arsenic or antimony; to produce a branched (iso) product and chemically treating said branched (iso) product to produce the corresponding lactate or acid of formula II.

31. (Previously Presented) A process for the production of a 3-hydroxy propanoate ester or acid of formula (III)

(III)



wherein R<sup>28</sup> is selected from H, a C<sub>1</sub>-C<sub>30</sub> alkyl moiety which may be branched or linear, and a C<sub>1</sub>-C<sub>30</sub> aryl moiety,

comprising the steps of:

carbonylating a vinyl ester compound of formula (IV)

(IV)



wherein  $R^{29}$  may be selected from hydrogen, lower alkyl, aryl, halo, cyano, nitro,  $OR^{19}$ ,  $OC(O)R^{20}$ ,  $C(O)R^{21}$ ,  $C(O)OR^{22}$ ,  $NR^{23}R^{24}$ ,  $C(O)NR^{25}R^{26}$ ,  $C(S)NR^{25}R^{26}$ ,  $SR^{27}$  and  $C(O)SR^{29}$  wherein

$R^{12}-R^{18}$  each independently represent lower alkyl, or aryl;

$R^{19}$  to  $R^{27}$  each independently represent hydrogen, lower alkyl, aryl;

and  $R^{30}-R^{32}$  represent hydrogen, with carbon monoxide in the presence of a source of hydroxyl groups and of a catalyst system, the catalyst system obtainable by combining:

- (a) a metal of Group VIII B or a compound thereof; and
- (b) a bidentate phosphine, arsine or stibine of formula (I) in accordance with claim 30

to produce a linear (n) product and chemically treating said linear (n) product to produce the 3-hydroxy propanoate ester or acid of formula (III).

32. (Previously Presented) A process according to claim 30 wherein one or more of the groups  $R^1$  to  $R^3$ ,  $R^4$  to  $R^6$ ,  $R^7$  to  $R^9$ ,  $R^{10}$  to  $R^{12}$ ,  $R^{13}$  to  $R^{15}$  or  $R^{16}$  to  $R^{18}$  together form a cyclic structure.

33. (Previously Presented) A process according to claim 30 wherein one or more of the groups  $R^1-R^6$  or  $R^7-R^{12}$  together form a cyclic structure.